

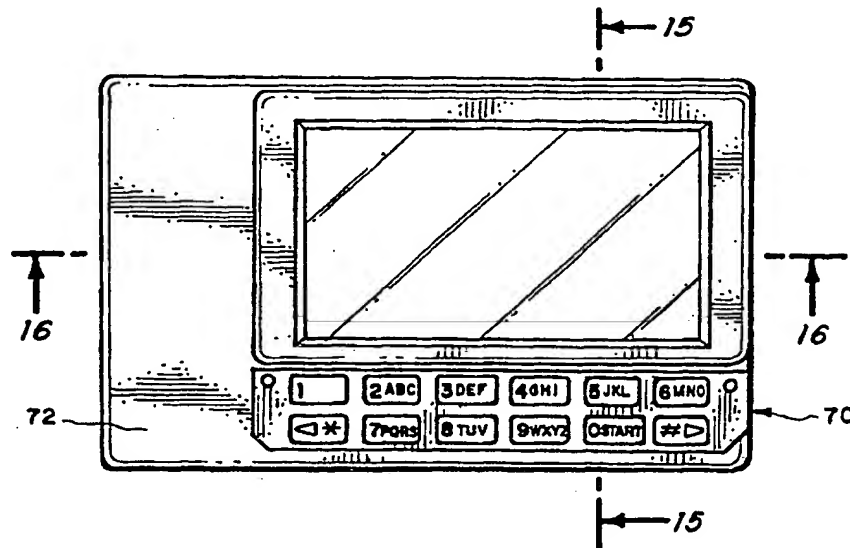
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>H04B 1/38</b>	<b>A1</b>	(11) International Publication Number: <b>WO 99/33193</b> (43) International Publication Date: <b>1 July 1999 (01.07.99)</b>
<p>(21) International Application Number: <b>PCT/US98/07186</b></p> <p>(22) International Filing Date: <b>7 April 1998 (07.04.98)</b></p> <p>(30) Priority Data: <b>60/068,280</b>      <b>19 December 1997 (19.12.97)</b>      <b>US</b></p> <p>(71) Applicant (for all designated States except US): <b>CELLBOOK, INC. [US/US]; Suite #17-477, 24000 Alicia Parkway, Mission Viejo, CA 92691-3923 (US).</b></p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): <b>HOLMES, Steve, R. [US/US]; 27641 Gold Dust Lane, Laguna Hills, CA 92653 (US). FRANTOM, Howard, B. [US/US]; P.O. Box 2273, Running Springs, CA 92382 (US). ALKIRE, John, C. [US/US]; Suite 104, 17195 Newhope Street, Fountain Valley, CA 92708 (US).</b></p> <p>(74) Agent: <b>HOLLAND, J., Mark; J. Mark Holland &amp; Associates, Suite 210, 3 Civic Plaza, Newport Beach, CA 92660 (US).</b></p>	<p>(81) Designated States: <b>CA, MX, US.</b></p> <p><b>Published</b> <i>With international search report.</i></p>	

(54) Title: HAND-HELD COMMUNICATION APPARATUS AND RELATED SYSTEM



## (57) Abstract

A method and apparatus for localized electronic data broadcast and reception of substantial volumes of readily updatable information includes providing a user with a hand-held, portable device (10) for selection, reception, storage, and retrieval of the information, providing at least one broadcasting source, and broadcasting information from the source so that, if the user is within range, the user may select, receive, store, and retrieve the information. The information is preferably transmitted in packets, and may include simultaneously or contemporaneously broadcasting differing sets of information. Programmability data may be transmitted with the information. The associated apparatus for selection, reception, storage, and retrieval of the substantial volumes of readily updatable locally broadcast electronic data includes a portable (10), hand-held body with a large, easily-read display screen and a plurality of keys positioned on the body to permit the user to select, receive, store and retrieve the information.

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HAND HELD COMMUNICATION APPARATUS AND RELATED SYSTEM

This invention claims the benefit of copending U.S. Provisional Patent Application Ser. No. 60/068,280; filed December 19, 1997.

Background of the Invention:

This invention relates to communication methods and devices generally, and more specifically to a method and apparatus for localized electronic data broadcast and reception of substantial volumes of readily updatable information. In addition to being capable of timely communicating large volumes of information, the invention is characterized by providing a user with a hand-held, portable device for selection, reception, storage, and retrieval of the information, and by providing automatic updating of that information at any time the device is within a local broadcast area. In the preferred embodiment of the invention, many transmitters can "update" many receivers (as those receivers travel within each transmitters range), without the transmitters or the receivers "knowing" where the user (carrying the receiver) came from or where the user is going. A user can thereby move randomly within a coverage area or areas and always receive updated information on the portable, hand-held device.

Information has become a prevalent part of today's world. While mankind's ability to produce information has increased dramatically, our ability to access that information has not kept pace. There is a growing demand to have easy, convenient, mobile access to real time information which is always up-to-date.

Media such as television and radio significantly limit a user's ability to "select" any particular information; other than changing the channel or turning off the TV or radio, the user has no control over what information the user views. Pagers and mobile telephones are useful for verbal or limited textual or similar transmissions, but (other than verbal transmissions), the volume of information transmitted is relatively small and discrete. To the extent that "large" volumes of data are transmitted, pagers

and mobile telephones or the like typically either cannot handle such volume, are unacceptably slow in receiving same, or suffer from a combination of those or other problems.

Laptop or hand-held computers provide valuable access to information stored on their hard-drives, and can be updated in a variety of ways. Typically, however, such computers are still relatively heavy and bulky and are not readily updatable with large volumes of "up-to-date" information without some affixing additional hardware to the computer and configuring specific software to accomplish the desired communication. Moreover, even though wireless transmission of data can be used for these computers (such as through infra-red communication or the like), typically the laptop is not automatically updated with information from remote source. Instead, such wireless communication is typically a "one transmitter" to "one receiver" situation, with the communication being specifically directed between the source (such as a server or computer network) and the one specific laptop computer. In other words, the server is not typically contemporaneously "broadcasting" the same large volume of data to a plurality of laptops.

To the extent such computers are becoming smaller and lighter, their cost remains prohibitive for many users and applications. Among other things, these units are typically "general purpose" computers, which makes them powerful and flexible machines but correspondingly contributes to their cost, size, etc.

While some services exist for "broadcasting" information to laptop (or other personal) computers, those services typically require the additional hardware and software mentioned above, and are typically limited in the "volume" of information they transmit. Services that broadcast news, sports, stock market, or Internet address information (to laptops, pagers or the like) commonly send only a "small" stream of information, rather than being capable (within a practical amount of time) of sending graphical images or other "large" quantities of data. Some of them require substantial additional steps to actually use even the "small" quantity of information; for example, certain Internet "news" services send only the addresses of web pages,

and a user must log onto the Internet in order to actually view the substantive information. In other words, the "large volume" of substantive information itself is not transmitted to the computer as part of the wireless "update" service.

Such "broadcasting" to pagers, laptops or the like also typically is done  
5 on a national or substantially large geographic scale. The messages are typically not readily customized on a local geographic level. Although to some extent paging companies can direct certain pages to all users within a region, this is limited both in how small a region can be and the number/amount of paging message/data. Messages can be sent to "groups" of users as well. Again, the limit on volume and speed is a differ-  
10 entiating factor from the device and system of the invention.

Printed books, maps, and the like also provide a means for storing and retrieving information. They tend to be relatively bulky, which limits their accessibility (people typically cannot readily carry with them all the printed books or maps that they might foreseeably need). It is also relatively difficult to retrieve information  
15 from printed books; the user must rely on his or her ability to scan the entire contents, or locate something using a general keyword index. The usefulness of books and maps is further limited if the information contained therein is subject to frequent change; the printed materials may be out-of-date shortly after they are printed. Such paper media can also be torn, smudged, or otherwise damaged, making it difficult or  
20 impossible to use the information.

Cellular telephones are useful for certain types of communication, but only operate within certain coverage areas. Once a user leaves the coverage area, the telephone typically either becomes non-functional or requires entry of additional data or information in order to "function" within a new coverage area (the latter process is  
25 known as "roaming"), although at least some cellular carriers have cross agreements where roaming services are provided automatically.

Within the last few decades, electronic books have come into existence. One of the biggest advantages of electronic information is the speed with which information can be found. Computers are infinitely faster at finding any or all

occurrences of specified data. However, as indicated above, accessibility is still at least somewhat of a problem. Some electronic information can only be accessed using expensive, non-portable computers. While new smaller portable computers have made this easier in recent years, they still do not address the critical issue of having up-to-date information. In order to achieve this portability, the user must take a copy of the electronic information with him in some electronic form. There has been no easy means to update this information in real time. The user is still typically restricted to using information that may be out-of-date very soon after being published.

As also indicated above, technology to allow wireless transmission of this data has been widely available for the past few years. However, this technology is practical only for very small sets of information, and is generally limited to a one transmitter to one receiver scenario. The time required to transmit a large set of information to many users is excessive, in itself defeating (or at least somewhat limiting) the purpose of having real time up-to-date information. Moreover, as further indicated above, the technology tends to be prohibitively expensive for many users and applications.

#### Objects and Advantages of the Invention:

It is, therefore, an object of our invention to provide a method and apparatus for easy, convenient, mobile access to substantially large volumes of real time information which is always up-to-date. Preferably, the apparatus and system permits a plurality of users to utilize the system simultaneously via their own handheld devices or units.

Prior art wireless communications systems typically transmit in the range of 19,000 to 28,000 bits/second. Cellular telephone technology just coming onto the market can approach 115,000 bits/second. Most pagers transmit at 9600 bits/second or lower, although some recent models have the capacity for up to 19,000

to 28,000 bits/second. Satellite transmissions can be up to 400,000 bits/second after their much, much larger total bandwidth is broken down to all the users (accordingly, the data stream received by any individual is not large).

The aforementioned object of communicating "large" volumes of information includes (but is not necessarily limited to) technology capable of greater volumes than 400,000 bits/second. In the preferred embodiment (discussed herein), the communication to each mobile hand-held unit can be up to 1.5-2 Mbits/second (four to five times the aforementioned 400,000 bits/second used with satellite transmission). In a soon-to-be commercially released version (with an updated chipset), the volume approaches 10 Mbits/second. While this volume is small compared to some hard-wired data transfer and communication, it is huge compared to prior art wireless systems such as pagers, etc.

The preferred method of distribution involves breaking down the information into small parts (or "packets"), each of which can be specifically applicable to a small geographic region. These packets are then transmitted wirelessly only within the selected applicable region or regions. In this way, the transmission technology available today can sufficiently handle the "smaller" quantity of information in order to always provide up-to-date real time information to the users in that region.

Any data that can be regionalized in this manner is a candidate for benefiting from the invention. By way of example, and not by way of limitation, such data includes: yellow page and white page style information; local advertising, traffic, weather, and news; homes for sale and apartment guides; sightseeing and tour guides; and movie times and event guides. All these are examples of data which is typically most useful within a relatively defined and limited geographical region, which tends to change with some frequency, where fast electronic access is very beneficial, and which would otherwise consume volumes of printed books or documents.

Another object of the invention is the provision of a method and apparatus of the aforementioned character, which uses different transmission frequencies

and/or data encoding methods to transmit many different sets of information to the particular region, for selective retrieval by users.

A further object of the invention is the provision of an apparatus or device which allows for selection, reception, storage, and retrieval of the aforementioned information being transmitted into the region. As discussed above, there is presently no single device which performs all these functions seamlessly. The preferred hand-held device of the invention is designed for ease of use and simplicity. It is small and lightweight for convenience and mobile operation. It has a display larger than other mobile communications units, such as mobile telephones and pagers. This display preferably allows more information to be viewed at one time by the user, and provides good legibility.

Still another object of the invention is the provision of a device of the aforementioned character, which includes a sufficient but simple set of keys to operate the various functions of the device. For simplicity, the preferred device has two primary control keys (typically used to navigate in a standard, consistent manner through the various displays and menus on the mobile unit screen). In the preferred embodiment, these two buttons primarily are used for advancing and backspacing through a series of cards. In subroutines and other programmed aspects the mobile unit 10, these can be used for scrolling up and down, moving left and right, moving forward and backwards, etc.). Ten other keys are labeled alphanumeric and allow the user to input all ten digits, 26 letters, and a space. Preferably, all of the keys can be dynamically programmed (the programming can be transmitted with the broadcast data), for example as "jump" buttons, allowing quick retrieval of related information. Alternative user input devices (other than keys) include, by way of example and not by way of limitation, touch-screen input and navigation and similar technologies.

An additional object of the invention is the provision of a device of the aforementioned character, which includes all the necessary built-in programming to facilitate the basic functions of reception, storage, and retrieval.



As indicated above, a further object of the invention is the provision of a method and device of the aforementioned character, which includes certain data transmitted with the information and hidden from the user, to allow a certain degree of programmability of the device. This programmability can be uniquely tailored for the information of which it is a part, and can differ by region, set of information, and even down to the individual data elements of the information. For example, information on how long certain information must be displayed on the hand-held device, and the location and size of data within the display can accompany the actual information during transmission. Hidden data can also trigger the device to execute built-in functions as well. Examples of such built-in functions include, without limitation, calendars, timers (such as a stop-watch), alarms, language display (in the preferred embodiment, the user can configure the mobile unit to receive and/or display in the user's language of choice, with multiple languages being simultaneously broadcast), system configuration, timing for automatic shut-off of the mobile unit, etc.

Another object of the invention is the provision of a portable, hand-held device or unit designed to allow storage and retrieval of selectable sets of information. Each set of information can be of any nature, as long as it can be organized into small logical pieces (which may alternatively be called cards or records). The sets of information are preferably continually transmitted wirelessly, and selectively received by the unit. The specific set of information to be received and stored is determined and selected by the user at his discretion.

An additional object of the invention is the provision of a device or unit of the aforementioned character usable in a system or method in which the sets of information transmitted are routinely updated. The unit constantly monitors the currently selected set of information to determine if it has been updated at any of one or more broadcasting stations. If so, the unit refreshes itself by receiving and storing newly transmitted "updated" information.

A still further object of the invention is the provision of a device or unit and method of the aforementioned character, in which the user is shown a message on the unit and given a brief opportunity to postpone the refresh process.

Another object of the invention is the provision of a device or unit and  
5 method of the aforementioned character, in which the sets of information available vary by geographic region. As a unit moves from one region to another, the unit detects updated information (or geographically different information) and triggers the aforementioned refresh process.

An additional object of the invention is the provision of a device or  
10 unit and method of the aforementioned character, in which the sets of information available to any particular hand-held unit can be restricted by encoded data within the information set, such as by matching a unique identification number built into each unit. The unit filters and/or allows storage of the set of information based upon such a match.

15 A still further object of the invention is the provision of a device or unit and method of the aforementioned character, in which the system and unit also incorporate two-way communication (such as occurs in current cellular telephone systems, certain pagers, and the like). Although the invention is intended to handle large volumes of data, "small volumes" of data also can preferably be transmitted and  
20 used over the system, either in a two-way or one-way embodiment.

Yet another object of the invention is the provision of a device or unit and method of the aforementioned character, in which the unit includes a display and a set of keys to allow the user to select and retrieve chosen pieces of information (or "cards"), contained in the unit's memory. In the preferred embodiment, the user can  
25 enter alphanumeric data by using the onboard keys. Each key represents multiple characters. The character chosen is determined by the number of times the key is pressed. Two keys are set aside to advance and backspace the character selection. The alphanumeric entry allows the user to retrieve matching pieces of information,

"cards", based upon any occurrence of the entered character string, using built-in programming.

Yet another object of the invention is the provision of a device or unit and method of the aforementioned character, in which the unit's program will generally operate uniformly regardless of the particular set of information stored in the unit's memory.

Still another object of the invention is the provision of a device or unit and method of the aforementioned character, in which each "card" within a set of information can contain data, hidden from the user, to control one or more functions of the unit and/or one or more functions of keys pressed by the user while the "card" is displayed. This provides a certain degree of programmability within the unit and method. For example, the machine addresses of other "cards" within the information set can be linked to certain key presses for quickly accessing and displaying related "cards," and/or the machine addresses of internal functions can be linked to certain key presses to quickly perform built-in routines, such as sounding an alarm from a built-in speaker, or selecting a different "set of information."

A still further object of the invention is the provision of a device or unit and method of the aforementioned character, in which each information "card" also contains data "hidden" from the user, which hidden data instructs the unit on display characteristics of the "card." For example, the minimum time length of display of the card when selected, and/or the size and relative position of characters and/or other data within the display. Each "card" can also contain tokenized data predefined for quick single key-press searches. Persons of ordinary skill in the art will understand that tokenizing is a common programming technique to improve usability and performance of electronic databases and related systems.

An additional object of the invention is the provision of a method of localized electronic data broadcast and reception of substantial volumes of readily updatable information. The preferred method includes the steps of: providing a user with a hand-held, portable device for selection, reception, storage, and retrieval of the

information; providing at least one broadcasting source; and broadcasting the information from the source so that, if the user is within range, the user may select, receive, store, and retrieve the information.

5 The broadcasting step of the aforementioned method may include broadcasting the information in packets, and may further include using data encoding methods and/or at least two transmission frequencies to transmit differing sets of the information for selective retrieval by the user. The step of providing a user with a hand-held, portable device can include providing a device having built-in programming to facilitate the basic functions of reception, storage, and retrieval.

10 The aforementioned method can further include one or more of the steps of transmitting programmability data with the information, and, hiding the programmability data from the user. The method can also include the step of selecting the programmability data based on the information, geographic region, set of information, and/or the individual data elements of the information.

15 Another object of the invention is the provision of apparatus for selection, reception, storage, and retrieval of substantial volumes of readily updatable locally broadcast electronic data, including: a body sized and shaped to be easily hand-held and portable by a user; a large, easily-read display screen positioned on the body for selective display of the data by the user; a plurality of keys positioned on the  
20 body to permit the user to select, receive, store, and retrieve the information.

In the aforementioned apparatus, certain of the plurality of keys includes may be primarily control keys, and others may be labeled alphanumeric and allow the user to input all ten digits, 26 letters, and a space. Certain of the keys may be programmable as "jump" buttons, allowing quick retrieval of related information.

25 Other objects and advantages of the invention will be apparent from the following specification and the accompanying drawings, which are for the purpose of illustration only.

Brief Description of the Drawings:

FIG. 1 is a front view of a preferred embodiment of a hand-held portable unit for selection, reception, storage, and retrieval of certain broadcast information, constructed in accordance with the teachings of the invention;

5                   FIG. 2 is similar to FIG. 1, but illustrates the display of exemplary data on said unit;

FIG. 3 is a schematic diagram illustrating a preferred method for "handing off" connections between broadcast/communication access points. More specifically, FIG. 3 illustrates a preferred system for organizing, storing and distributing information from a computer server to broadcasting access points, with a shadow figure of a person (a user) moving through the broadcast areas with a unit (such as illustrated in FIGS. 1 and 2) and receiving and using information from the various broadcast points;

15                   FIG. 4 is a graphical illustration of certain aspects of the preferred transmission technology (also described as direct-sequence spread-spectrum, or DSSS);

FIG. 5 is a schematic illustration of description of the preferred receiver unit (such as illustrated in FIGS. 1 and 2) and interface communication used in the preferred invention;

20                   FIG. 6 is a functional block diagram illustrating a preferred overview of the unit of FIGS. 1 or 2;

FIG. 7 is similar to FIGS. 1 and 2, but illustrates a top view of a preferred embodiment of a preferred hand-held unit;

25                   FIG. 8 is a sectional view of the device shown in FIG. 7, taken along line 8-8;

FIG. 9 is a back view of the device shown in FIG. 7, illustrating (among other things) the preferred location for batteries;

FIG. 10 is a sectional view of the device shown in FIG. 11, taken along line 10-10;

FIG. 10A is an enlarged view taken along line 10A of FIG. 10;

FIG. 11 is a preferred housing member that may be used in connection with the assembly of the apparatus of FIG. 7;

FIG. 11A is a side view of the device shown in FIG. 11, taken along  
5 line 11A-11A;

FIG. 12 is a bottom view of the device shown in FIG. 7;

FIG. 13 is a top view of a preferred LCD and control-button board or panel for mounting in the housing of FIGS. 9-11;

FIG. 14 is similar to FIG. 7, but illustrates one of the many alternative  
10 embodiments of the mobile unit/receiver of the invention;

FIG. 15 is a sectional view of the outer shell of the device shown in FIG. 14, taken along line 15-15; and

FIG. 16 is a sectional view of the outer shell of the device shown in FIG. 14, taken along line 16-16.

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#### Description of Preferred Embodiment:

The drawings show a preferred embodiment of the apparatus and method of the invention.

A preferred embodiment of a hand-held device or mobile unit 10 is  
20 best illustrated in FIGS. 1-2 and 7-13, and its preferred circuitry is schematically illustrated in FIG. 6. The preferred embodiment of the invention includes, among other things, one or more of such portable, hand-held communication devices or units 10, as well as the overall system for broadcasting and/or otherwise communicating with one or more such devices 10, user interaction with the device, and related aspects of the  
25 system.

In its preferred embodiment, the system provides consumers or users mobile access to current information that is updated using wireless technology. The device and system are useful, among other things, for temporary use by persons visit-

ing a certain area (they can use the device to obtain relevant local information, concerning restaurants, entertainment, tourist sites, shopping centers, museums, theaters, transportation, and other information, as well as current news and information and calendars of upcoming events), or for a "permanent" user who may own or carry their  
5 device with them almost all the time, to have relevant, selectable, current information at their fingertips.

The preferred mobile unit or device 10 is a highly integrated portable hand-held system that includes some of the most advanced circuits available. The mobile unit 10 preferably includes state-of-the-art architecture of a low cost single-  
10 chip processor and a Graphical User Interface (GUI). It combines the features of a Personal Digital Assistant (PDA), a Personal Information Manager (PIM), and a Portable Data Terminal (PDT).

Preferably, an advanced microcontroller such as microcontroller 50 (FIG. 6) controls the mobile unit 10. In the preferred embodiment, microcontroller 50  
15 is a 32/16 bit controller specifically designed for the portable hand-held market. The preferred microcontroller 50 features a small footprint, low power consumption and low cost with 3.3V fully static operation. In the preferred embodiment, some of the key features of the microcontroller are modules such as a built-in LCD controller 52 (FIG. 6), pulse-width modulator (PWM), timers include a real time 24 hour clock,  
20 master and slave serial peripheral interface (SPI), universal asynchronous receiver/transmitter (UART). The preferred LCD controller uses system RAM rather than dedicated RAM for display memory, allowing faster paging, low power consumption and lower cost. The Bus bandwidth used by the LCD controller is low, thereby enabling the microcontroller core to have sufficient computing bandwidth for  
25 other tasks.

In the preferred embodiment, main power to the mobile unit 10 comes from two AA batteries 54 (FIG. 6), preferably removably retained in a chamber 22 of housing 20, FIGS. 9 and 10. One of the many alternative embodiments of the hand-held portable unit of the invention is illustrated in FIGS. 14-16 as unit 70, and

includes a battery storage chamber 72 on one side of the unit. Among other things, this orientation can "slim" the mobile unit, making it easier to place into a shirt pocket, for example. Mobile unit 10 can readily include other features, such as a flip-over cover (not shown, but which would protect the LCD screen). Persons of ordinary skill in the art will understand that any of a wide variety of other configurations can be readily utilized in connection with the invention.

Thus, the unit 10 preferably includes ready and affordable power replacement. Power is preferably stepped up and regulated to 3.3V, 5.0V and -22V DC for the various circuits, by regulating means such as a regulator 56, FIG. 6. Persons of ordinary skill in the art will understand that any suitable regulation and step-up arrangement and settings may be effectively utilized within any particular embodiment of the invention.

The preferred receiver circuit 58, FIG. 6, uses a serial peripheral interface in 32-bit packets to communicate with the "broadcasting" microprocessor server 30, FIG. 3. In the preferred embodiment, each of these packets consists of an 8-bit ID followed by 24 bits of data, although persons of ordinary skill in the art will understand that other packeting arrangement can be effectively utilized. The receiver software on the microcontroller 50 configures the receiver by sending a series of configuration packets (i.e., receiver control, frame assignment, and address enable information) at various times, such as when the mobile unit is turned on, when the user reconfigures or resets the device, and/or even as part of a relatively continuous response to broadcast of data. These configuration packets are preferably stored in an initialization buffer on the microcontroller 50. The initialization data in that buffer is preferably segmented by functionality into four segments: driver initialization, notification, message manager, filter and receiver initialization.

In the preferred embodiment, the mobile units 10 preferably save power (and conserve battery life) by "waking up" at predetermined intervals which coincide with the broadcast intervals. Persons of ordinary skill in the art will understand that the particular interval for "wake up" can be varied over the course of any



given day, and that a constant update (as opposed to periodic) is possible, subject to a greater drain on the battery power. In the current embodiment, the largest power drain on the mobile units 10 occurs during these intervals of "receiving" broadcast updates; although the user's operation of the unit (to search, review, etc.) consumes  
5 some battery energy, the amount is relatively small in comparison.

The preferred process of receiving and processing data generally consists of two stages. In the first stage, the interrupt service routine on the microcontroller 50 receives raw data from the mobile unit's receiver 58 (via an antenna 60 and intervening circuitry, such as the circuitry illustrated in FIG. 6). Every time the  
10 receiver 58 has new data, it asserts an interrupt to the microcontroller 50. The microcontroller 50 acknowledges the interrupt with the interrupt handler. The interrupt handler on microcontroller 50 then receives raw data via serial peripheral interface communication (see FIG. 5) from the mobile unit's receiver 58 and stores the data in a circular queue. In the second stage, the microcontroller 50 periodically calls the  
15 receiver function to read data out of the circular queue. The mobile unit's receiver 58 then analyzes and assembles the original "page" to be displayed on the LCD .

The preferred microcontroller 50 uses a timer interrupt to check the two pointers for new data in the circular queue. If the receiver 58 finishes assembling the original page and no other fragment of the page is expected, the receiver 58 noti-  
20 fies the microcontroller 50. The microcontroller 50 then places the new page in the mobile unit's main memory buffer (on microcontroller 50) for access by the user.

The preferred method of user interaction and manipulation of the information in the mobile unit 10 is via a keyboard 12 (FIGS. 1, 2, 7 and 13). Persons of ordinary skill in the art will understand that any of a wide variety of interface technologies may be effectively utilized in connection with the invention, including touch-  
25 screen or the like.

In the preferred embodiment, the keyboard 12 is an array of two rows by 6 columns (12 position) membrane switches, although persons of ordinary skill in the art will understand that any of a variety of keyboards and keyboard arrangements

may be effectively utilized in the invention. The keyboard 12 is the preferred main interface between the user and the mobile unit's microcontroller 50. While waiting for user requests, the mobile unit's microcontroller 50 periodically scans the keyboard 12. If the microcontroller 50 is in its sleep (low power) mode and a key on keyboard 12 is pressed, the microcontroller 50 becomes fully functional and turns on power to the LCD, displaying the first frame or "card". The mobile unit 10 then displays screens as requested by the user's keyboard input.

Preferably the cards transmitted and displayed in the system are images (as opposed to just text data) which can also include hidden text, programming and/or tokenized data and other instructions. Users can view an image and quickly recognize what it is, where a computer (including one such as the mobile unit 10) have great difficulty recognizing and interpreting images. The preferred use of images allows the mobile unit 10 to provide the user with a "highly visual" piece of information. The data the mobile unit 10 needs to operate is the hidden textual data behind each card. This blend of image and data allows the "computerization" of information only a human can readily understand.

In other words, the hidden data is preferably data that the mobile unit 10 can act on in a precise and consistent manner. The image data associated with that hidden data contains a visual message the user can act on. The image data can also portray or include text to be read by the user, but which is still not "understood" by a computer.

Such instructions may include, by way of example, programming for what the keys 12 do when that particular screen is displayed, display characteristics for the screen (such as fade-in or fade-out), etc. Animations can be provided by, among other things, displaying a series of "card images" in a controlled pattern of timed display. The images can be video images, text images, or any combination.

Persons of ordinary skill in the art will understand that, although the preferred system utilizes "image cards", the system can readily accommodate text as well, and can even be modified to also facilitate two-way pager or cellular telephone

types of communication, if appropriate circuitry (not shown) is added to the transmitting (broadcasting) unit or units and the mobile receiver or receivers 10.

The preferred card images transmitted to and used in the receivers 10 can be an index, an operating system page, a menu, an advertisement, or any graphical display. In the preferred embodiment, the mobile unit 10 includes one or more pages of instructions to assist the user in operating the mobile unit 10. Preferably, each of the images can contain a picture of any type of information or message that a user might understand. The hidden data preferably contains the instructions that the mobile unit 10 would use to make one image "act" like a menu and another "act" like an index, etc. To the mobile unit 10, each "card" is treated like any other "card" in that the card is acted upon based upon the "instructions" in the hidden data.

The display 14 (FIGS. 1, 2, and 7) preferably is a Liquid Crystal Display (LCD), and is a 320 by 200 graphic display. Although the preferred embodiment uses a display that was custom designed for the mobile unit in order to meet the desired low power and high resolution and small footprint requirements, persons of ordinary skill in the art will understand that any of a wide variety of LCDs or other displays may be designed and used in the invention. Preferably, the LCD 14 is used to communicate the data and graphic pages/advertisements to the user that have been retained in the mobile unit 10's main memory. In the preferred embodiment, the LCD controller (microcontroller 52, FIG. 6) fetches display data directly from system memory on microprocessor 50, through periodic DMA transfer cycles.

As indicated above and as illustrated in FIG. 5, the preferred mobile unit 10's receiver 58 preferably uses a standard serial peripheral interface to communicate with the controller. The preferred interface between the two PC Boards 50 and 58 is a low profile IDE type connector with 10 pin by 2 row header spaced at 0.05 inch center to center (although 0.10 inch center to center is also desirable because it is an industry standard dimension; persons of ordinary skill in the art will understand that this can be any suitable dimension). The male side of the header is on the solder

side of the Receiver PC Board, and the female or socket side is mounted on the component side of the main Controller PC Board (host).

The following signals are preferably used to communicate with the two devices (pin numbers refer to FIG. 5) (the "substance" of the signals preferably remains at least similar in any particular embodiment of the invention, but the precise pin numbers, voltages, etc. can be modified within the parameters of any particular application):

<i>Signal</i>	<i>Preferred Location</i>	<i>Description</i>
RESET	JP3 Header, pin 17	the reset signal to the receiver. This pin is used by the host software to reset the receiver
READY	JP3 Header, pin 1	connected to an interrupt pin on the host. When the receiver wants to send data to the host it will assert the READY signal until the end of a 32-bit transfer
SCK	JP3 Header, pin 13	the clock supplied by the host. This input pin is connected to the SPI clock output pin on the host MPU
SS	JP3 Header, pin 20	used to select the receiver, before every data transfer between the receiver and the host MPU, the host needs to assert SS to select the receiver
SPRXD0	JP3 Header, pin 9	the signal the receiver uses to transfer data to the host
SPTXD0	JP3 Header, pin 5	the signal the host uses to transfer data to the receiver
VCC	JP3 Header, pin 2	the 5.0V regulated DC power
VDD	JP3 Header, pin 6	the 3.3V regulated DC power
GND	JP3 Header, pin 19	the power ground

The mobile unit 10 is preferably fabricated from any suitable light-weight, rugged materials. Its screen 14 preferably is a high-resolution, pixel-based LCD the size of a standard business card, measuring approximately 3.5 by 2 inches. A wide range of sizes may be effectively utilized, but this approximate size is a good balance between desired smallness of the overall unit 10 (which enhances portability) and desired "largeness" of the display 14 (which enhances readability and effective communication with the user). The user may scroll through data on the display 14 via

the keyboard 12, illustrated as a custom 12-button membrane key pad located near the LCD 14.

Alphanumerics are preferably entered at the key pad 12 in a manner similar to programming a feature telephone. Each mobile unit 10 preferably has 2-4 Mb RAM for data storage purposes. The "card" data is preferably stored on flash (permanent) memory and on static RAM, helping to reduce the likelihood of loss of data (as compared to DRAM memory storage) even while changing the batteries. The data is preferably displayed as bit-mapped graphics on the LCD 14.

Data is transmitted to the mobile unit 10 by one or more remote transmitters 32, FIG. 3, connected directly (via any suitable connecting hardware, such as fiber optic, coaxial cable or the like) to the bus of a personal computer or server 30. The broadcasting network preferably includes cells 34 (typically called microcells), which in the preferred embodiment are similar to cellular telephone systems. By strategically locating the cells 34, the range of connectivity of the broadcast to the user is extended. Individual microcells 34 preferably overlap (as illustrated in FIG. 3) to allow continuous communication with mobile units as users move within the network coverage area, seamlessly "handing off" users from one cell to another as the users roam through a covered area. Each microcell 34 preferably provides a range from 100 to 300 feet, although persons of ordinary skill in the art will understand that other ranges can be readily used by appropriate selection and positioning of transmitting cells 34.

Although the words "continuous" and "continuously" are sometimes used herein to describe the communication between the cells 34 and the units 10, the units 10 and the system do not require literally "continuous" data transmission. Some transmission interruption is permissible (and desired, as indicated, to comply with FCC and/or other regulations), so long as relatively/virtually constant communication occurs.

In the preferred embodiment, the receiver 58 uses the 2.4 GHz Spread Spectrum band for simplicity and security reasons. Data streams are continuous and

the data is approximately 2 to 4 Mbps repeated continuously. The block diagram shown in Figure 6 denotes the preferred actual circuits. Power saving is optimized via on-chip power-down control lines on each device.

5 The antenna 60 feeds the two-stage Low-Noise Amplifier (LNA) 62, which provides the front end and is responsible for tuning and down-converts the received signal to an IF level.

A monolithic dual synthesizer 64 with on-board prescalers provides LO signals for RF and IF down conversion, based on digital phase-lock-loop design techniques.

10 The demodulator 66 is preferably a half duplex IF sub-system for quadrature modulation applications, and contains all the necessary functions for processing I and Q signals. The demodulator also preferably includes a High Gain Limiting amplifier, Receive Signal Strength Indicator (RSSI), and baseband anti-aliasing and shaping filters.

15 The preferred Spread Spectrum Receiver circuit 58 integrates I&Q 3-bit 44 MSPS A/D converters and all necessary baseband digital signal processing functions to support half-duplex packed data. Differential phase shift keying (PSK) modulation schemes combined with programmable PN codes of up to 16 bits produce the necessary chip rates to provide excellent range and data rates of up to 4 MBPS.

20 Various components of the invention have been obtained from third parties (some on an exclusive contractual basis), but the inventors believe that other sources such as Aironet, Proxim, Windata, P-Com, Solectek, Glenayne, Lucent, E.F. Johnson, OverLan, Symbox, Ericsson, Compuquest, and WaveLan are technically capable of providing satisfactory substitute components, if provided the information  
25 set forth herein.

The microcontroller 50 is responsible for the overall control and operation of the unit 10. This controller 50 monitors the key pad 12 for user input, stores the incoming data in RAM, and displays the data on the LCD 14.

To minimize power consumption, the micro-controller 50 preferably includes two clocks. The first operates at low frequency and is used for basic timing. The second is the high-frequency clock and is used for high-speed processing. The low-speed clock operates most of the time, thereby conserving the battery life. The high-speed clock is required only when message traffic is coming to the receiver 58. By combining low-voltage, low-leakage ICs, and discrete components, as well as power-down circuitry to turn off elements in the system when not in use, battery life is preferably extended greatly. A receive power-on control circuit detects when the protocol data stream is not present and generates a signal which automatically powers down the mobile unit 10. The preferred modulation is phase-shift keying (PSK) because it is more power efficient than frequency-shift keying (FSK) which is the standard technique for FHSS.

Under this mode, the transmitter network 30, 32 continuously broadcasts packets with embedded sequence numbers, and the receiver 58 in the mobile unit 10 automatically synchronizes to the data being broadcast. Missing packets are detected by comparing the embedded sequence numbers with the expected sequence numbers. Packet error rate is also continuously calculated and used in the unit 10 to determine whether the data has been received successfully.

In the preferred embodiment, direct-sequence spread-spectrum (DSSS) generates a redundant bit pattern for each bit to be transmitted, although persons of ordinary skill in the art will understand that frequency hopping or any other suitable protocol may be utilized. Figure 4 illustrates the DSSS approach to dividing up chip code. This bit pattern is called a chip (or chipping code). The longer the chip, the greater the probability that the original data can be recovered (and, correspondingly, the more bandwidth required). Even if one or more bits in the chip are damaged during transmission, statistical techniques embedded in the mobile unit 10 can recover the original data without the need for re-transmission. To an unintended receiver, DSSS appears as low-power wideband noise and is rejected (ignored) by most narrowband receivers.

The preferred DSSS applies a unique approach to reduce interference from outside sources on the desired signal. For example, the de-spreading operation 68 multiplies the incoming signal by a local replica of the spreading waveform. This correlates with the desired signal to collapse it to the data bandwidth, while spreading all other signals. After the despread signal is filtered to the data bandwidth, the noise outside the new narrower band-width is discarded.

There are numerous advantages to the system of the invention. Because of the GUI and familiar, consistent keyboard operation, new users do not require special training to operate the unit 10. As described herein, a reduced instruction keyboard 12 is preferably used to enter instructions. The FCC does not require a license for operation of the preferred embodiments of the mobile unit signal receivers 10. As indicated above, to assist users, the preferred embodiment includes a set of basic operating instructions (preferably displayed when the unit is turned on, displayed like any other piece of information in mobile unit 10) and the preferred two navigation keys have consistent and prompt responses. The preferred mobile unit 10 provides virtually instantaneous feedback to the user, allowing him/her to more effectively learn what happens when a button is pressed. The image on the screen will be replaced by another screen very fast. Other technology, primarily PCs, need considerable time sometimes to process the user input and act on it. The preferred mobile unit 10 accomplishes this speed improvement because it has no internal moving parts and works entirely within RAM, which is very, very fast - in the nanosecond range. PCs typically use hard drives in which most of the data is stored, and they operate in the millisecond range. Pages/cell phones suffer from too many buttons (or too many functions associated with each button depending on what the user is accessing) and too small a display screen.

In part because the response to user input is so prompt in the preferred embodiment, the user typically can readily perceive that the user's instructions have been received by the mobile unit 10. In the preferred system of the invention, the entire image on the LCD will change as a user moves through the cards because the



cards will be visibly different from each other. Even if that one "card" following another were somewhat similar, the aforementioned speed of response makes it likely that the user's continued pressing of the input key would fairly quickly move to a "different" appearing card. With most other devices, PCs in particular, commonly  
5 only a tiny part of the screen changes based upon the user input, and those changes are sometimes not perceived by the user. Certainly if the whole screen changes, the user notices.

The output power of the preferred wireless LAN system is very low, much less than that of a hand-held cellular telephone. Since radio waves fade rapidly  
10 over distance, very little exposure to RF energy is provided to those in the area of a wireless system.

The network (illustrated in FIG. 3 as including PC 30 and transmitters 32 in cells 34) preferably can be installed with as many nodes as desired. In FIG. 3, three nodes are shown, but the system of the invention can function as a simple one-  
15 node system or complex large numbers of nodes and/or large physical areas by adding access points (such as transmitters 32) to boost or extend coverage.

By broadcasting information via the system of the invention, businesses can specifically target a geographic area with a customized message, to attract likely patrons. The system makes it easy for businesses to customize and revise their  
20 message or messages to meet their needs, and to have multiple or differing messages broadcasting in the same or different geographic areas.

The size of each message is limited only by the size of the mobile unit 10's display screen 14, which (as noted above) is preferably approximately 2" high by 3.5" wide. Among other things, this is the size of a standard business card, and  
25 therefore has the benefit of being a familiar size. Each screenful of information can be described as a "page." The display 14 preferably occupies a much larger portion of the unit 10 than most other hand-held electronic devices, so the consumer can easily view each message. As indicated above, the screen 14 is graphical and can therefore display eye-catching images in addition to text.

A business can choose to have multiple pages to convey its message and, using the unit's "jump button" feature, each page can be directly linked to another page of the business's choice. Using the preferred "hidden" data described herein or some equivalent technology, many helpful and eye-catching features can be included in the message displays. For example, each page preferably can have its own unique set of display characteristics, such as fade-in and fade-out, a display pause time, an "auto-jump" feature, and the ability to pan into neighboring pages. Using the auto-jump feature, simple animation can be added to a message. With some simple creativity, an interactive multiple-part message can be delivered to the consumer (the user of the unit 10).

In certain applications of the invention, attached to each message are key words that describe the business's services, features, benefits, specials, etc. These key words, chosen at the business's discretion, are used during the unit 10's text search function (a search similar to searches conducted by word processors and within databases, which function is preferably provided as an imbedded sub-routine in the mobile unit 10) to identify businesses with services matching those being sought by the consumer. For example, a gourmet Italian restaurant might list the key words "gourmet" and "Italian" along with other general terms like "food" and "restaurant." For very quick searches by the consumer, each main message page is also preferably listed in a major category such as restaurants, shopping, theater, etc.

A unique characteristic of electronic wireless distribution (such as preferably used in the invention) is the ability to add, delete, or modify a business's or person's advertisement or message on demand. Such modifications require only a simple manipulation of the database at the main server 30 (FIG. 3) to update the transmitted signal in any region. No longer is a business locked into one message for an entire year, or locked out of a publication because the cutoff date was missed. A restaurant can, for example, change its message each day to reflect the special of the day, or a theater can display how many seats are available for tonight's show, or a shopping center can display seasonal messages.

In certain applications, the network can be used to divide areas into regions to help pinpoint the delivery of a business' message to consumers within its locale, thereby increasing the cost effectiveness of the message. A business can display its message in other regions as well, if it chooses.

5           Although the preferred embodiment uses an unlicensed broadcast spectrum and typically only broadcasts indoors in a range of 300-1000 feet and outdoors for up to 1-3 miles, persons of ordinary skill in the art will understand that a wide range of performance characteristics can be selected and implemented in any particular embodiment of the invention. Among other things, the broadcasting antenna  
10       can be shielded and/or directionally broadcast and/or used on a line-of-sight basis, all of which approaches can affect the size of the "local" coverage area 34 of any particular antenna 32. Likewise, interference in the broadcast/receiving area can affect the geographic scope and clarity of the broadcast. Where relatively "small" geographic regions are targeted, correspondingly "smaller" parts of a relevant database may be  
15       needed for any particular broadcast. For example, broadcasting restaurants in the south part of a given county or city might avoid the need to broadcast all the restaurants in the county, city, or neighboring counties or cities. Persons of ordinary skill in the art will understand that the invention permits targeting broadcasts down to as focused an area as a building-by-building basis.

20           There are several important competitive advantages for the invention when it is used as an advertising medium, as compared to prior art technologies.

          For example, the invention allows instant and frequent changes in the message being delivered to the patron. Changing messages can be used creatively by businesses to achieve higher retention and return rates by the patron, in addition to the  
25       more obvious circumstances like correcting misprints and easily accommodating address changes. Furthermore, there are no missed "publishing deadlines" with the system of the invention, which deadlines can cause up to one-year delays in conventional print publications.

The preferred graphical display of the invention allows advertisers to present an eye-catching dynamic message to its prospective patrons, including animation, matched only by television and the World Wide Web. The services offered by the cellular and paging industries (as well as wireless Internet access) are typically  
5 lifeless, static text-only messages.

The information in the system of the invention is up-to-date and accurate. Conventional sources of certain similar information can be as much as one year old.

The information in the system of the invention is easy to find and use  
10 on demand. Printed media is typically bulky and difficult to search, and information is not available on demand from other electronic media that is usually not searchable at all.

The preferred messages in the system of the invention are highly visual. The graphical nature of the display makes the images more recognizable and  
15 easier to comprehend than many or all competing technologies. For example, text-only displays with limited line length are difficult to read and remember.

The preferred unit 10 is hand-held and lightweight, making it very portable and convenient to carry. It would be highly impractical and undesirable to carry all the alternative sources of information that can be contained electronically in  
20 each unit 10.

As described herein, one of the primary applications of the system of the invention consists of small compact broadcast stations 32 and hand-held lightweight receivers 10. The broadcast stations 32 continually transmit data, and are strategically placed to allow automatic update of every receiver unit 10 as those units  
25 come into range. Although the preferred 2.4 GHz radio frequency band is designated for public use by the Federal Communication Commission ("FCC") (and is therefore not subject to FCC licensing), both the transmitters 32 and the receivers 10 must meet certain operating specifications set forth by the FCC, and are subject to a one-time FCC approval process.

The invention can be expanded geographically into and throughout any desired region. Major travel destinations might benefit most immediately from the invention, in that hotels could distribute the units 10 to persons unfamiliar with the area. Foreign language versions of the messages and multi lingual images can be  
5 readily prepared and used.

Additional applications and markets for the technology include retirement communities and military bases. These communities are typically enclosed, allowing for easy broadcast coverage, and their residents are a homogeneous consumer group with great appeal to advertisers. These markets provide several substantial advantages. First, in such circumstances the units 10 may be sold to the users  
10 (such as by promoting perpetual discount coupons offered by advertisers on the system). Such sales can substantially offset (or even exceed) the capital required to build new receiving units 10. Equally as important, the potential advertiser base is no longer limited to those businesses targeting travelers. Such markets are a natural  
15 application of the invention, requiring little change to marketing strategy.

Another application of the invention involves the real estate industry. By developing a residential real estate database specifically for realtors, the invention can be used to provide to realtors instant and up-to-date access to information regarding a home for sale (such as while the realtor is driving a prospective homebuyer  
20 through the neighborhood). In such applications, receiving units 10 can be provided to realtors for a monthly fee. Realtors can also be charged a fee for each home they listed in the system database.

Many potential custom applications exist. For example, the invention can be used at trade shows, on cruise ships, at sporting events, in gaming settings  
25 (sports-book and race track reporting), in large commercial facilities, and at other public gatherings to deliver information wirelessly and in real-time, either on a temporary or permanent basis. "Permanent" installations would include, by way of example, broadcasting antennas installed in hotels or other buildings on a "permanent" basis. Temporary installations can be readily and affordably achieved with the inven-

tion (such as at sporting events, etc.), because the invention is so much more "mobile" than prior art "broadcasting" systems. Typical broadcasting antennas usable in the system (such as those that can be made by persons with skill in the art of antennas and transmitter boards can collapse so small that the antenna, computer, and connecting hardware (e.g., a "broadcasting network" equivalent to network 30, 32 of FIG. 3) can all be transported in a suitcase or even a briefcase. The antenna can even be "built onto" the transmitter board, thereby eliminating any components external to the PC. The broadcasting network components can be installed and removed in less than one day, whereas typical licensed spectrum transmitters take at least several months for the installation process (to obtain permits, construct the installation, etc.).

Enough broadcasting facilities 32 in a given area provide blanket coverage for the system. Such blanket coverage allows any user, not just a visiting guest, to use the receiving unit in his area. As discussed above, information can be customized and targeted to specific areas. As the user enters a region, the unit 10 can automatically load updated information specific to the area. This effectively expands the usefulness of the invention to the entire local population and allows the units 10 to be marketed to consumers in general.

The future potential applications beyond this are virtually unlimited. Serving the information delivery business, every setting where a large quantity of information is needed in a timely and accurate manner represents a future opportunity for the invention.

Although the apparatus and method of the invention have been described with some particularity, the specific designs, constructions and steps disclosed are not to be taken as delimiting of the invention. Among other things, various modifications will at once make themselves apparent to those of ordinary skill in the art, all of which will not depart from the essence of the invention and all such changes and modifications are intended to be encompassed within the scope of the appended claims.

Claims:

## WE CLAIM:

5

1. A method of localized electronic data broadcast and reception of substantial volumes of readily updatable information, including the steps of:  
providing a user with a hand-held, portable device for selection, reception, storage, and retrieval of said information;

10

providing at least one broadcasting source; and  
broadcasting said information from said source so that, if the user is within range, the user may select, receive, store, and retrieve said information.

2. The method of Claim 1, in which said broadcasting step includes broadcasting said information in packets.

15

3. The method of Claim 1 or Claim 2, in which said broadcasting step includes using at least two transmission frequencies to simultaneously transmit differing sets of said information for selective retrieval by said user.

4. The method of Claim 1 or Claim 2, in which said broadcasting step includes using data encoding methods to transmit differing sets of said information for selective retrieval by said user.

20

5. The method of Claim 1 or Claim 2, in which said step of providing a user with a hand-held, portable device includes providing a device having built-in programming to facilitate the basic functions of reception, storage, and retrieval.

25

6. The method of Claim 1 or Claim 2, including the step of transmitting programmability data with said information.

7. The method of Claim 6, including the step of hiding said programmability data from the user.

8. The method of Claim 6, including the step of selecting said programmability data based on said information, geographic region, set of information, and/or the individual data elements of said information.

5 9. Apparatus for selection, wireless reception, storage, and retrieval of volumes of readily updatable locally broadcast electronic data, including:  
a body sized and shaped to be easily hand-held and portable by a user;  
receiving means affixed to said body and capable of receiving the data at rates greater than 400,000 bits/second;

10 memory means affixed to said body, for storing said data;  
a display screen positioned on said body for selective display of said data by the user, said display screen being capable of displaying GUI images; and  
user input means affixed to said body, for permitting a user to operate the apparatus and manipulate the data.

15 10. The apparatus of Claim 9, in which said user input means includes a plurality of keys positioned on said body to permit the user to select, receive, store, and retrieve said information.

20 11. The apparatus of Claim 9, in which said plurality of said keys includes at least two control keys which are consistently used to navigate through said data and several other keys that are dynamically programmable based on information in the database.

12. The apparatus of Claim 9, in which said user input means includes touch-pad means positioned on said body.

13. The apparatus of Claim 12, in which said touch-pad means constitutes said display screen.

25 14. The apparatus of Claim 9, in which said receiving means is capable of receiving the data at rates at least as fast as 1,200,000 bits/second.

15. The apparatus of Claim 9, further including means for two-way communication with a remote transmitter of said data.



16. A method of localized electronic data broadcast and reception of readily updatable information, including the steps of:

providing a plurality of broadcasting antennas;

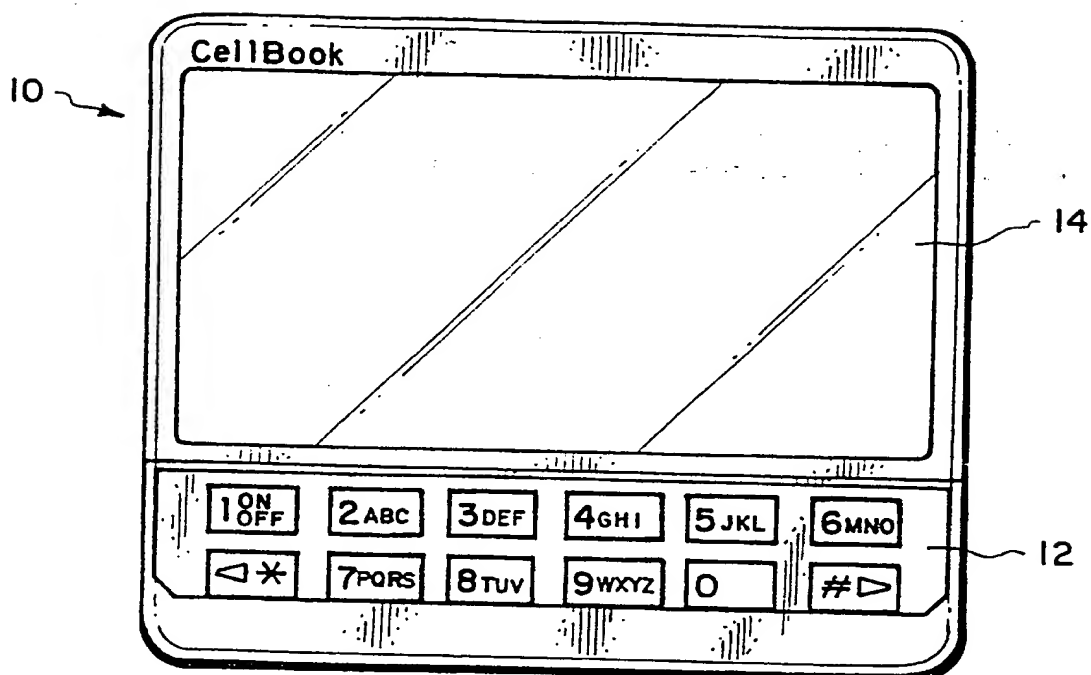
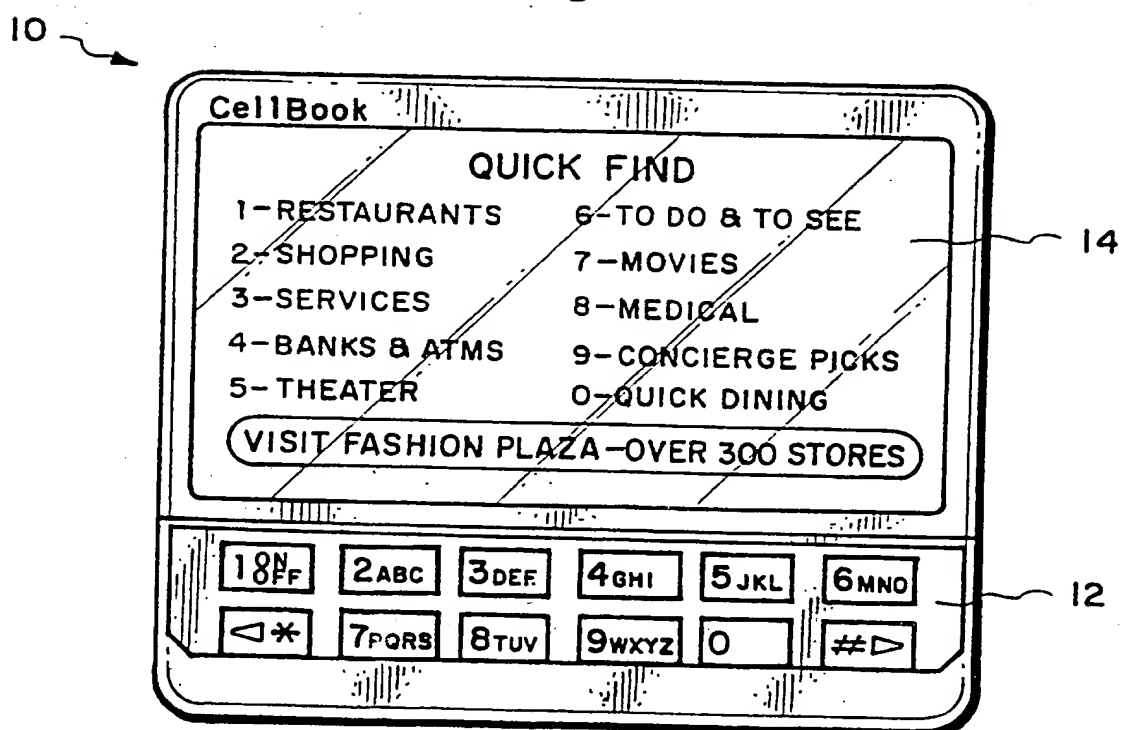
affixing said antennas to a computer server;

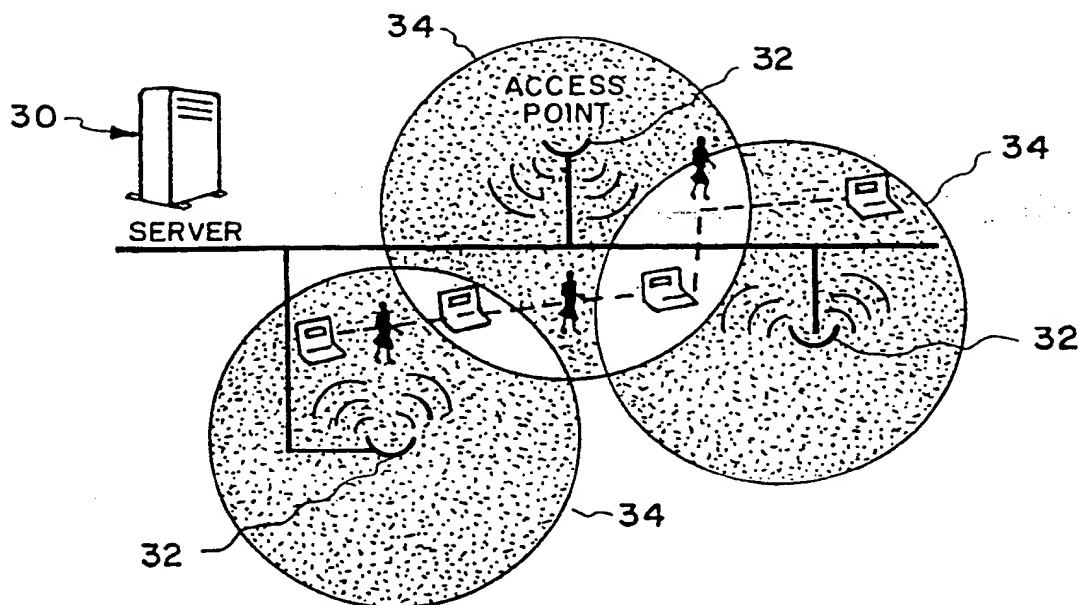
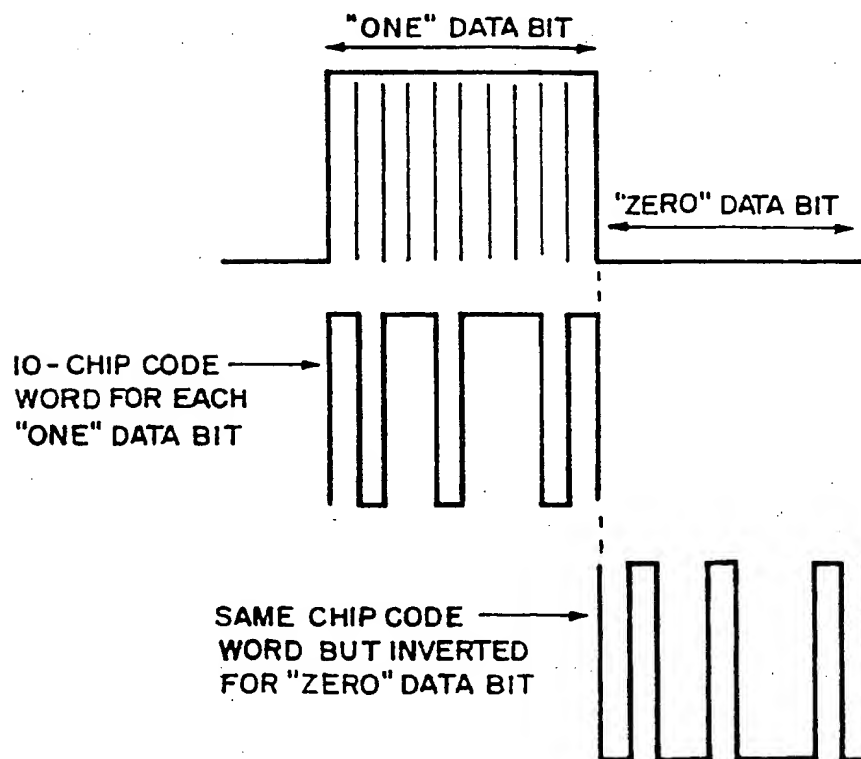
5 operating said computer server to broadcast said information at speeds greater than 400,000 bits/second;

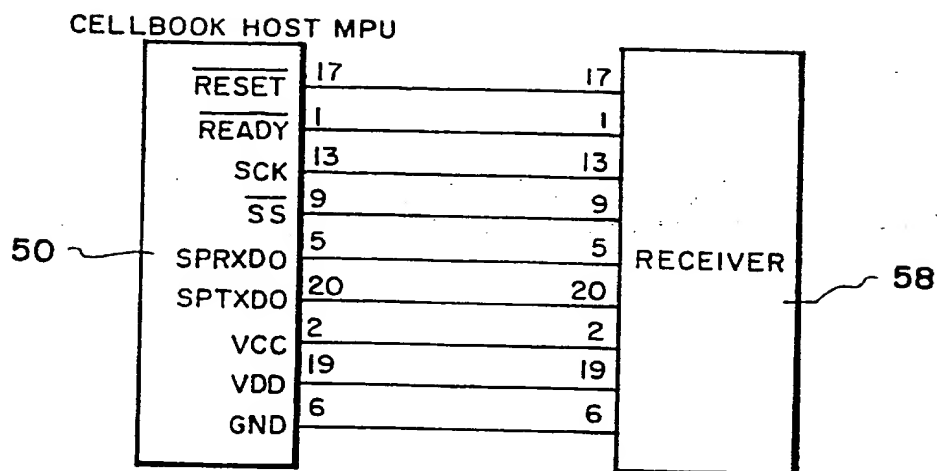
providing a plurality of users with hand-held, portable devices configured to automatically receive and store said information and to facilitate the user's selection and/or retrieval of said information;

10 said broadcasting antennas being positioned to overlap broadcast coverage areas so that a user may continue to receive said information as the user moves throughout the coverage area.

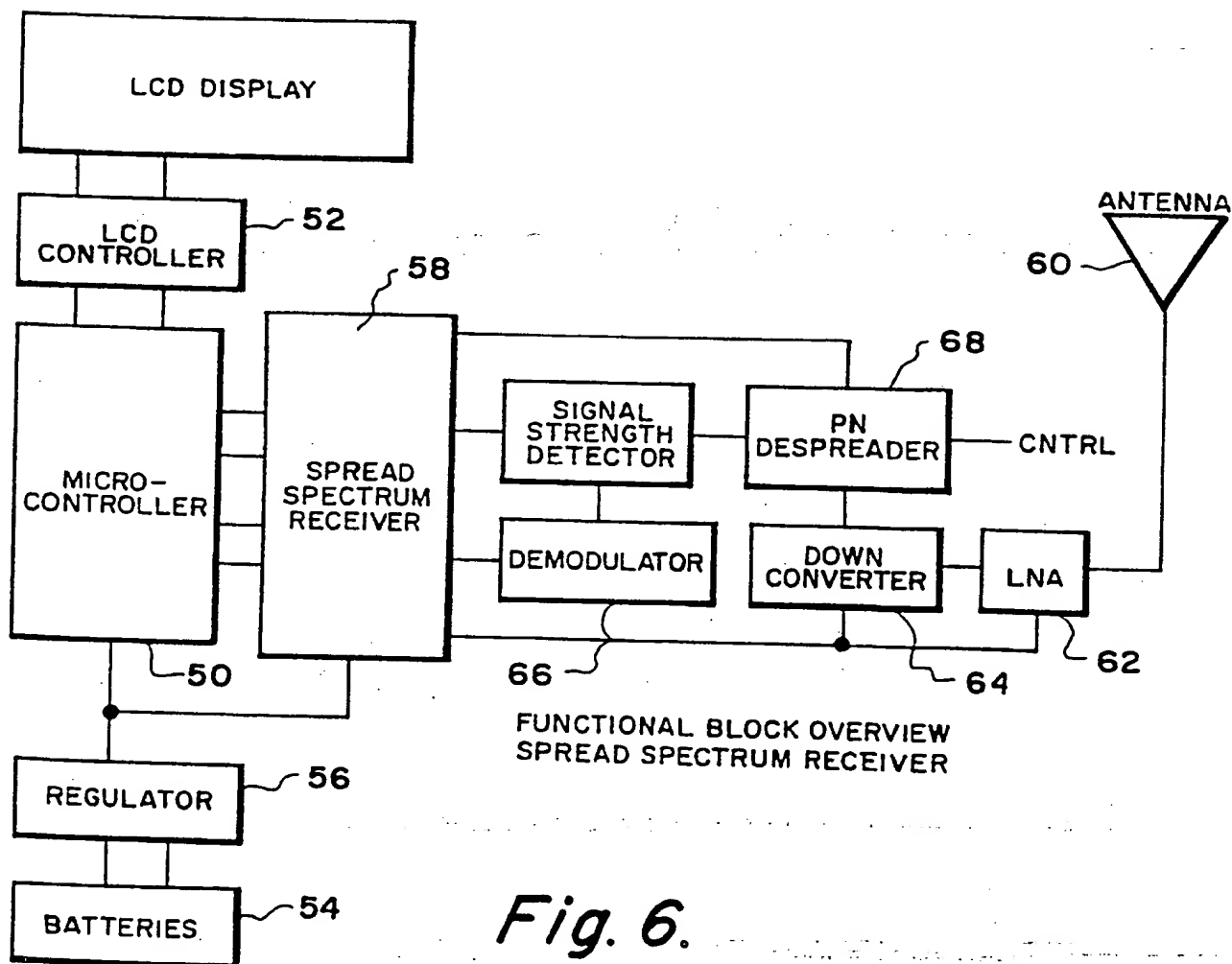
17. The method of Claim 16, including the steps of providing a plurality of said computer servers, and operating said computer servers to broadcast different information to selected of said antennas, whereby the particular said different information received by any particular said hand-held, portable device depends on  
15 where the user happens to move with said hand-held, portable device.

*Fig. 1.**Fig. 2.*

*Fig. 3.**Fig. 4.*



*Fig. 5.*



*Fig. 6.*

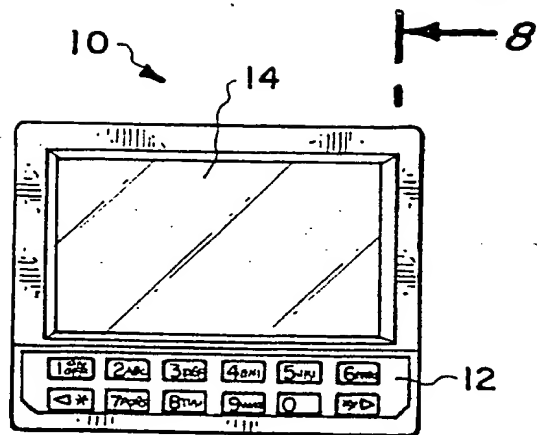


Fig. 7.

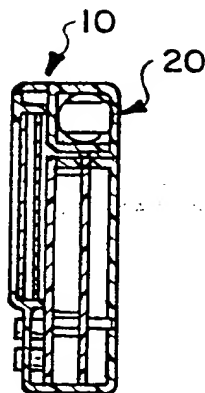


Fig. 8.

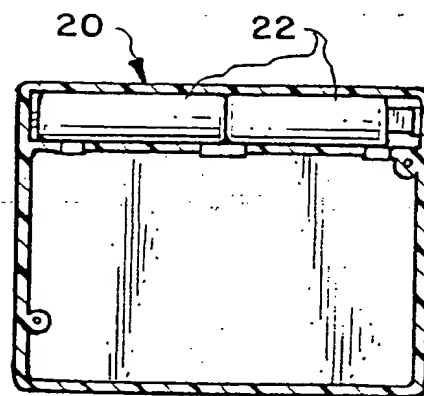


Fig. 9.

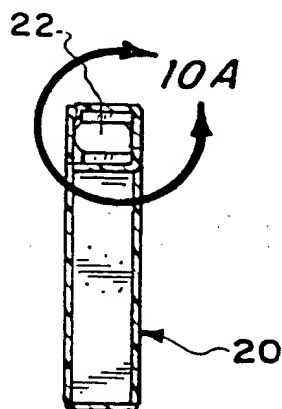


Fig. 10.

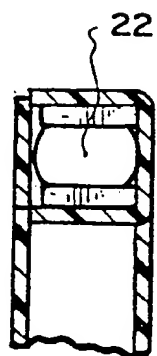


Fig. 10A.

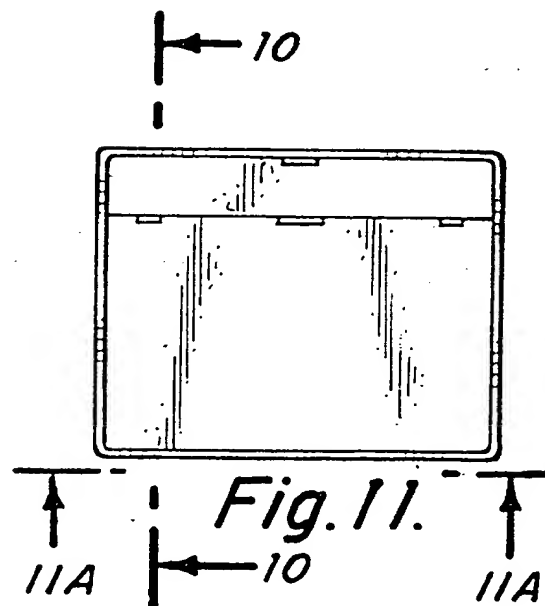


Fig. 11.

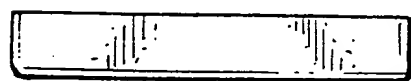


Fig. 11A.

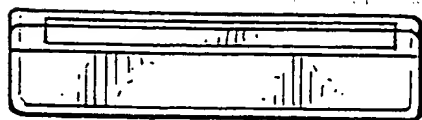


Fig. 12.

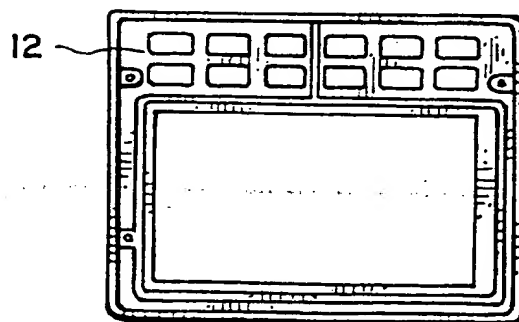
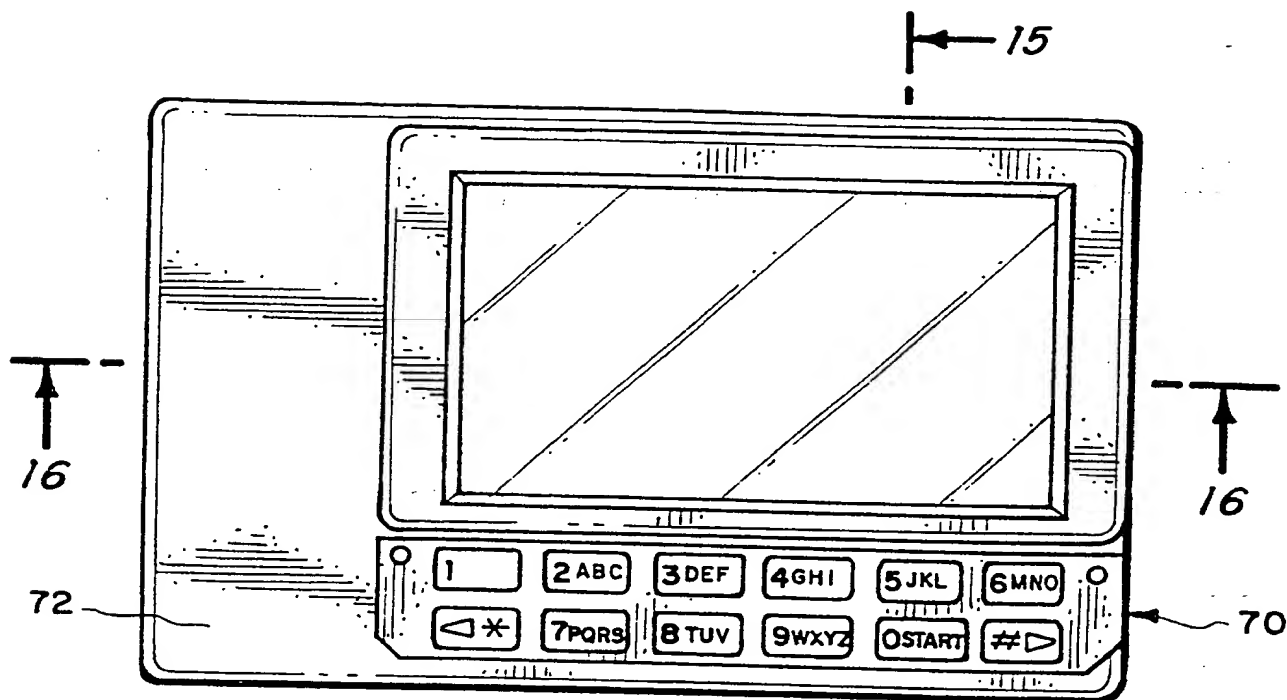
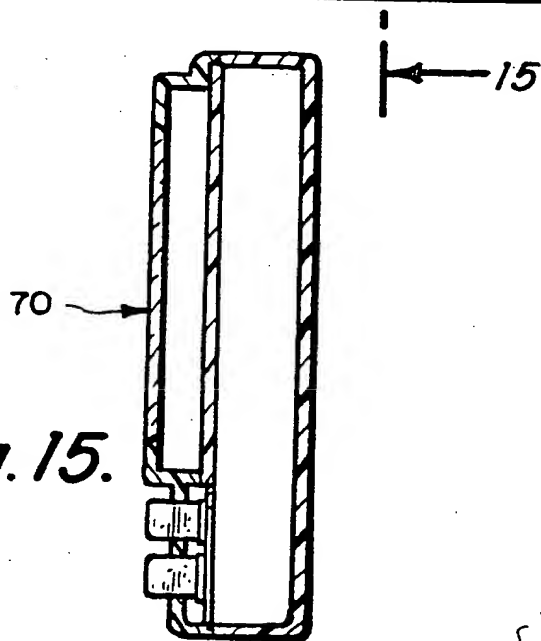


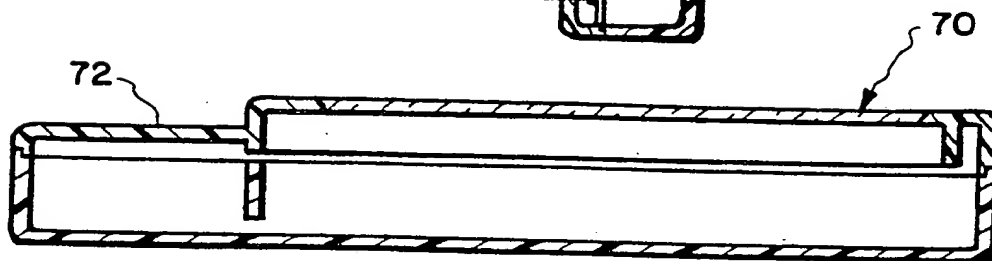
Fig. 13.



*Fig. 14.*



*Fig. 15.*



*Fig. 16.*

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US98/07186

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y, P	US 5,715,243 A (MAY) 03 FEBRUARY 1998, SEE FIGS. 1-10.	1-17

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US98/07186

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04B 1/38

US CL :455/575

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/575, 412, 418-420, 31.3, 38.1-38.2, 38.4-38.5, 73, 507, 517, 66, 550, 90, 145, 154.1-154.2, 351; 340/825.44

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
noneElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
none

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,627,525 A (KUDOH ET AL) 06 MAY 1997, SEE ALL FIGS. 1-9.	1-17
Y	US 5,258,751 A (DELUCA ET AL) 02 NOVEMBER 1993, SEE FIGS. 1-6.	1-17
Y	US 5,630,207 A (GITLIN ET AL) 13 MAY 1997, SEE FIGS. 1-6.	1-17
Y	US 5,659,890 A (HIDAKA) 19 AUGUST 1997, SEE FIGS. 1-15.	1-17
Y	US 5,694,120 A (INDEKEU ET AL) 02 DECEMBER 1997, SEE FIGS. 1-4	1-17
Y	US 5,452,288 A (RAHUEL ET AL) 19 SEPTEMBER 1995, SEE FIGS. 1-11.	1-17

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	* T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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* L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	* & document member of the same patent family
* O document referring to an oral disclosure, use, exhibition or other means	
* P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

19 JUNE 1998

Date of mailing of the international search report

OCT 13 1998

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